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Automated Enforcement: A Compendium of Worldwide Evaluations of Results

Excessive speeding, red-light-running, and other high-risk behaviors are often associated with crash fatalities and injuries in the United States. Traditional law enforcement alone is not enough to deter high-risk driving behaviors. Automated enforcement systems (AES) use image-capture technology to monitor and/or to enforce traffic control laws. The goal of AES is to significantly increase the perceived chance of being caught, thus creating a change in behavior that will translate into a crash reduction.

TransAnalytics, LLC, prepared a compendium of automated enforcement approaches and systems implemented around the world for NHTSA and characterized the impacts, based on available research literature.

Methods

A systematic information and literature search of electronic databases from vendors and technical libraries, Internet sources, and contacts with professional association members yielded a large quantity of national and international AES evaluation studies. The studies were then filtered and ranked according to: (1) study methodology; (2) outcome measures; (3) number of treatment and comparison sites; (4) other treatment characteristics; (5) other evaluation features; and (6) confounding variables. These factors were used in deciding which studies should be included in the compendium.

The literature review focused on two specific technologies, speed enforcement and red-light cameras. Automated speed enforcement systems include fixed cameras that monitor traffic speeds without a human operator, or mobile camera operations deployed in vehicles by law enforcement agents. A third, less common type of automated speed enforcement is "speed-over-distance" systems that calculate vehicle speeds based on start- and end-point times. Red-light cameras photograph vehicles that enter intersections after signals have turned red. Offenses can be detected through sensors buried in the pavement that are tied to a timing system that integrates the traffic signal and pole-mounted camera. In both technologies, photographs of illegal behaviors and license plate numbers are taken and reviewed by the jurisdiction, usually by a law enforcement office. Then, the vehicle owner may receive a citation.

Research Findings

About 90 studies from 16 countries were identified as potential evaluation studies of automated speed enforcement applications; 40 were evaluation studies. About 75 studies from 9 countries were identified as potential evaluation studies of automated red-light-running enforcement; 44 were determined to be evaluation studies. Retrospective studies (literature reviews, meta-analyses, and systematic reviews from the past two decades) were also reviewed.

The studies generally reported safety benefits, but program parameters, sampling and evaluation methodologies varied so much that safety effects reported cannot be generalized. A lack of control for regression-to-the mean effect in most of the studies, along with other design issues, may have resulted in overestimation of program benefits.

In the area of automated speed enforcement, 13 key studies met the final inclusion criteria. About half of these studies documented reductions in speeds as well as crashes, demonstrating a possible relationship between the treatment and observed safety effect. The best-controlled fixed-camera speed enforcement sites reported estimates of injury crash reductions of 20 to 25 percent. For mobile enforcement programs, two studies looked at system-wide effects and found reductions in crashed of 25 to 30 percent in daytime unsafe-speed-related crashes and daytime injury crashes.

For red-light-camera enforcement, seven studies fit the evaluation criteria. Overall, key studies supported the notion that red-light cameras can reduce crash severity at intersections with high red-light-running. The reviewed studies demonstrated crash effects consistent with results in previous red-light-camera evaluation studies, specifically a decrease in right-angle crashes, and an increase in rear-end crashes. Several studies included economic effects analysis based on an aggregation of right-angle and rear-end crash costs for various injury severity levels. These studies demonstrated that red-light cameras do provide a moderate aggregate crash-cost benefit and contribute to decreasing fatal and injury angle and left-turn crashes.

Discussion

Existing research suggests that AES can improve safety at high-crash locations. Based on the limited existing evidence, covert mobile enforcement programs seem to result in safety improvements. However, the exact magnitude of the safety gain, how far it will extend, and how much it will reflect a change in the targeted behavior (e.g., a decrease in speed) rather than to another behavior change (e.g., choosing an alternate route) are still uncertain.

Considerations for future implementations and research of speed and red-light-running AES include: (1) designing controlled, randomized experiments; (2) critical selection of treatment and matched control locations; (3) applying empirical Bayes methods to the calculation of treatment effects to provide more reliable estimates; (4) assessing crash severity data to gauge safety impacts; and (5) investigating strategies to maximize AES benefits.

How to Order

To order the report *Automated Enforcement: A Compendium of Worldwide Evaluations of Results,* (119 pages), prepared by TransAnalytics, write to the Office of Behavioral Research, NHTSA, NTI-130, 400 Seventh Street SW., Washington, DC 20590, fax 202-366-7096 or download from www.nhtsa.dot.gov. Kathy Sifrit, Ph.D. was the contracting officer's technical representative for this project.

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